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Foundry Fuel Economy

In common with all other industries, the foundry is being asked to reduce its fuel consumption. The first consideration, never to be forgotten, is that the remaking of a casting which has proved faulty involves a maximum waste of fuel. For instance, when making iron castings, the production of 10 per cent. of wasters sends up the melting fuel bill on good castings, say, from 10 per cent. to over 11 per cent., whilst there is still required the coke to remelt the scrapped castings. Thus, cheeseparing in using melting coke may result in an indirect heavier consumption. The salvaging of the cupola dump, coupled with greater attention to the furnace lining repairs, can introduce worthwhile economies. Whilst some of the more modern mould ovens and core stoves are particularly economic to operate, there are still far too many which are neither good drying machines nor models of thermal efficiency. There is still too little appreciation of the fact that clothes cannot be dried for weeks on end in damp tropical climates. We believe that good data could be obtained by inserting a fan in the stack flue of a loaded mould oven and running it cold for a few hours. This initial experiment could well be followed by firing so as to yield an oven temperature of 100 deg. C., 150 deg. C., and so on, always avoiding the stewing of the moulds in a hot, damp, stagnant atmosphere. The designers of moulds stoves have been handicapped in the past by the lack of data upon which to work. They could give better service if proposals were based on the reduction of moisture content from "*x*" to "*y*" per cent. of masses of sand weighing "*a*" tons in "*b*" hours. It must be confessed that in many plants it has been considered satisfactory if moulds charged into the oven in the late afternoon were in a fit condition to withdraw, core up and close next day. Of other types of furnaces used in the foundry industry, they are, generally speaking, thermally efficient; yet it desires stressing that thermal efficiency is not necessarily synonymous with metallurgical efficiency. Some processes require a reducing atmosphere, which either denotes a function for the carbon other than its combustion to produce heat or as a safety measure to preclude the presence of free oxygen. An example of the former is when melting high steel charges in the cupola and, of the second, many classes of reheating furnaces.

Because fuel is used in such relatively large quantities in metallurgical establishments, there is perhaps a natural tendency to waste in minor matters. Fires and lights are left burning quite unnecessarily in offices and mess rooms. In die casting shops, judging by the hot atmosphere, there must be much misapplied heat; at least there always seems to be many gas jets blazing away to little purpose. Then there are the indirect wastages of fuel resulting from the running of empty sand mills, of unnecessarily prolonged periods of time for tumbling barrels; faulty hose and valves in the compressed-air lines; and from allowing the sawing machines to continue to operate long after the runners have been cut off. A section where economy can often be effected is in the drying and heating up of ladles. In each individual works it means but little, but, when considered in the light of being repeated throughout a great industry, there will be a realisation of the very serious wastage that can accrue. Another unconsidered trifle is the fuel used for starting up cupolas. Many valuable packing cases have been so consumed, and perhaps not an inconsiderable quantity of serviceable patterns. Actually, we would prefer to see popularised either a standardised firelighter or the use of a gas poker, for a fixed minimum period. Finally, a survey should be made of every furnace, oven and stove, to ascertain whether, by the use of insulating material, a better thermal efficiency, and consequently fuel economy, could not be brought about.

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CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

HIGH-DUTY CAST IRON

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have found Mr. Braidwood's Paper, "Cupola-Melted High-Duty Cast Iron," particularly interesting, and would like to make a few observations on the lines indicated during the discussion on its presentation to the Glasgow Branch.

With reference to his ladle "inoculation" with carbon, I first tried this as a means of increasing the carbon content in connection with the melting of borings, where the carbon content could be brought very low, *i.e.*, sometimes lower than there was any demand for.

From this work, which is referred to in a Paper to the Falkirk Branch, January, 1940, I concluded that in fact the quantity absorbed in the metal had an effect out of all proportion to its magnitude, at least so far as fluidity was concerned.

The following statement also appears therein:—"Much practical experimenting could be usefully carried out as to its effect on structure, which on preliminary test does not seem very marked, although the additional dissolved graphite seems to be of small size; about two-thousandths of an inch in length."

This Paper, of course, referred to cast iron which never shows other than random graphite.

Tensile and transverse tests were taken as a matter of routine in addition to the fluidity tests, but no change in this was observed as a result of the graphite addition.

The graphite used was in flake form and had an absorption of about 50 per cent. Perhaps Mr. Braidwood could check the effect of his treatment on fluidity, as the fluidity of this class of metal often determines the freedom or otherwise from defects due to dissolved gases, a practical aspect of the making of high-duty iron castings which cannot be ignored unless in very simple designs.

Impact tests were not carried out, and so the important conclusion arrived at by Mr. Braidwood was missed. This seems to emphasise his contention that impact tests should be made as regularly as tensile tests.—Yours, etc.,

WM. Y. BUCHANAN.

Dunconnell, Thomson Avenue, Johnston,
Glasgow.
July 15, 1942.

INSTITUTE OF BRITISH FOUNDRYMEN

NOTES FROM THE BRANCHES

London. The Branch will resume its non-stop programme towards the end of August, when Mr. J. H. Williams, B.Sc., has promised a talk on "Ladle Metallurgy." In September Mr. John Gardom is to review the work of the Technical Committee—a lecture which drew a large and interested attendance when given recently in Birmingham. Later in the session Papers have been promised from Mr. A. Burgess, Mr. W. Gladwell, Mr. F. Hudson, and Mr. C. H. Kain.

NEW BRITISH CHEMICAL STANDARDS

Bureau of Analysed Samples, Limited, whose wartime address is at Markington, Harrogate, announce two new British Chemical Standards steels, *viz.*:—

13 *per cent. Chromium Steel No.* 211.—Cr, 13.81 per cent.; C, 0.247; Si, 0.29; S, 0.010; P, 0.017; Mn, 0.34 per cent.

0.3 *per cent. Lead Steel No.* 212.—Pb, 0.28 per cent.; C, 0.415; Si, 0.13; S, 0.023; P, 0.054; Mn, 0.73 per cent.

Each sample has also been analysed for minor elements such as As, Ni, Cr, Cu, V, Ti and Co.

The 13 per cent. Cr steel No. 211 will serve as an analytical standard for the "straight" chromium type of rustless steel, whereas the 0.3 per cent. Pb steel No. 212 is a Ledloy free-cutting steel, and is useful as an analytical standard for the determination of lead in steel. Where possible the methods for Pb, S, and P recommended by the Iron and Steel Institute Sub-Committee on Standard Methods of Analysis have been used. Supplies may be obtained from any laboratory furnisher or direct from Bureau of Analysed Samples, Limited.

COBALT COMPOUNDS IN VITREOUS ENAMELS

In order to conserve supplies of cobalt compounds for use in essential products, the Ministry of Supply (Non-Ferrous Metals Control) desires the consumption to be reduced in a number of industries, including the vitreous enamelling industry. As a result of discussions between the Institute of Vitreous Enamellers and the Ministry the following agreement has been reached:

(1) As cobalt oxide is essential and not entirely replaceable as an adherence-promoting agent in sheet steel ground coat enamels, it will continue to be released for this purpose. The amount used, however, must not be greater than 0.5 per cent. in the fritted enamel.

(2) No more compounds of cobalt will be released for the production of colouring oxides or coloured enamel frit. Existing stocks acquired for this purpose can, however, be used up. Special cases involving Government specifications are being examined individually.

Charting Steelmaking Processes.—Sequential steps in the manufacture of ferrous castings, open hearth, electric and Bessemer steel and puddle iron are incorporated in a chart of blueprint form entitled "Outline of Metallurgy of Iron and Steel," recently prepared by F. E. Sanborn, Columbus, O. The chart tabulates the representative analyses of various pig-irons, and also each phase in the conversion of iron ore to such finished products as pipe, tubing, wire, tinplate, sheets, etc.

Production of Uniform Steel for a Light Castings Foundry

By C. H. KAIN and L. W. SANDERS

Paper presented at the Thirty-Ninth Annual Conference of the Institute of British Foundrymen in London

Summary

A description is given of the routine employed to produce liquid steel at the periods when it is most required in a light-castings foundry. Two processes are used, the basic electric and the Tropenas converter. Stress is laid on standardised charging and working in the electric furnace, and a special technique employed in the cupola supplying iron for the converter. It is claimed that by the employment of these methods, loss of production caused by the pouring floor waiting for the furnace, or vice versa, *is eliminated. Appendices give details of the preparation of the linings, the properties of the steels made, and a note on fluidity.*

Introduction

The methods outlined in this Paper are employed in one foundry producing 95 to 100 tons of finished carbon steel castings weekly. Although this is a modest tonnage, it is just double the output for which the plant was originally designed. As the castings are almost entirely light and made in green sand, the floor space must be utilised to the utmost for the production of moulds. A typical week's output was made up of over 5,000 castings totalling 97 tons. The average weight is 38 lbs., with very occasional castings falling in the hundredweight and upward class. This output can only be maintained by careful planning and working to a pre-determined programme. The planning is based on the number of moulds which can be produced in a given time by the equipment installed. The core output is adjusted to suit this, the moulds finished, cored up, and closed as made.

It is then necessary to have liquid steel available to pour the moulds, in order that the floor may be cleared and the cycle repeated. This Paper is a description of the steps taken to standardise steel production so that moulds may be poured when ready.

Two processes are in use, the basic electric and the Tropenas. This combination has two great advantages:—

(1) The basic electric can use a wide range of scrap and produce a low-phosphorus/low-sulphur metal, the remelt from which can be used in conjunction with West Coast hematite in the Tropenas to produce steel with a phosphorus and sulphur content comparable with electric steel.

(2) The electric furnace can be adjusted to produce a heat of steel at precise intervals (of 4 hrs. in this case), day and night, whilst the Tropenas can produce heats at high speed during the peak casting period, which in most foundries is during the afternoon.

As there are so few castings of large weight, it is not possible to open up the nozzle on a mould of several hundredweights capacity and, if it were possible, it would be undesirable as the standard steel is at much too high a temperature for heavy castings. Hand-shanking from both types of furnaces is practised to a great extent, small moulds being poured in this manner without difficulty. Table I shows the time-table which is worked in the foundry under consideration and each process is considered in three phases, as shown in Table II.

TABLE I.—*Tapping Times.*

Electric furnaces.		Converter.
A.	B.	
2 a.m.	—	1.30 p.m. Soft.
6 a.m.	—	2.15 p.m. Hard.
—	9 a.m.	2.45 p.m. Soft.
10 a.m.	—	3.15 p.m. Soft.
—	1 p.m.	4.0 p.m. Hard.
2 p.m.	—	4.30 p.m. Soft.
6 p.m.	5 p.m.	5.15 p.m. Soft. Delayed to permit 5 p.m., heat from B.
10 p.m.	—	—

TABLE II.—*Division of Processes.*

Electric furnace.	Tropenas converter.
1. Charging and melting	Melting and desulphurising.
2. Oxidising (converting and slagging off)	Blowing (converting).
3. Reducing (refining) Finishing and tapping.	Finishing and tapping.

Table III shows the standard time-table which is aimed at for both processes.

It is not proposed to deal in detail with the chemistry of the processes, as both are fairly well

Uniform Steel for Light Castings

known, but to describe the mechanism of standardised steel production.

TABLE III.

Electric furnace.	Time.	Converter.	Time.
	a.m.		p.m.
Previous tap complete	9.0	End of heating period	12.45
Fettling furnace complete	9.15	Fettling complete ..	12.57
Charging complete ..	9.45	Charging complete ..	1.0
Melting complete ..	11.45	Blowing complete ..	1.22
Slagging off complete	11.50	Finishing and recarburizing	1.25
	p.m.		
Finishing complete ..	12.50	Ready to tap ..	1.28
Ready to tap ..	12.55	Tap complete ..	1.30
Tap complete ..	1.0		

PART I—BASIC ELECTRIC PRACTICE

The furnaces in use are of the Electro-metals type with two top electrodes and a conducting hearth. They are rectangular in shape with nut and screw operated tilting and elevating gear. The maximum capacity is 50 cwt. and charging is entirely by hand. The nominal rating is 650 kva. The basis of the process lies in standardisation of the charges, a controlled boil and speed in working.

Charging and Melting

The charge is made up of 45 to 47 cwt. of mixed cold scrap of variable size and consisting of 75 per cent. of scrap and 25 per cent. of steel turnings. The heavy scrap is charged first, directly under the electrodes, light scrap is charged around the electrodes and in the centre of the furnace, and the steel turnings round the sides. It is found that even slight variation from these proportions causes a considerable lengthening of the melting time; thus an increase to 30 per cent. for the turnings increases the time of a heat by 15 min. The time taken to charge the scrap is between 20 and 30 min., according to the size. The heavier scrap takes longer than the medium variety which can be readily handled by shovels.

The aim is to melt from the bottom upwards, the arc being concentrated on the heavy scrap to form a pool of metal quickly. By this means a constant arc is maintained. Lime is added with the charge, about 75 lb. to the ton being used. This quantity is varied according to the condition of the scrap, dirty or rusty scrap receiving more and high quality material rather less.

Melting is conducted as rapidly as possible with a load of 5,000 amp. at 80 to 85 volts. The time taken to melt a charge of 45 to 47 cwt. from the cold is usually 2 hr. During the melting period care is taken to prevent excessive heat in the centre of the furnace by frequently pushing the charge towards the centre. This prevents over-oxidation or direct attack by the arc on the furnace bottom. Further lime is added from time to time to form slag. When the bath is all clear-melted, the temperature should be just high enough to ensure a liquid slag under normal conditions.

Oxidising and Slagging Off

The temperature is increased as additions of broken ore are made to remove the oxidisable elements. Properly worked, a bath condition arises when a critical temperature is reached and a violent boil takes place. It is essential that this boil be secured. A short and vigorous boil is preferred to a long slow boil, carbon being reduced from approximately 0.38 to 0.09 per cent. in 10 min. This short vigorous boil on a rising temperature gradient appears to be a crucial point in successful practice. Thus, if no boil takes place, the slag is glassy and reflects heat causing the roof to run and making the later formation of a true reducing slag very difficult. Also the absence of a boil appears to be associated with sluggishness in the finished steel.

A long slow boil at constant temperature leaves a bath which is very difficult to kill and which wastes a great deal of time during the finishing period. The essentials are to melt a bath with sufficient carbon (0.35 to 0.45 per cent.) to cause a strong boil, to feed ore slowly and steadily whilst the temperature is raised and not to cause boiling at a low temperature by considerable stirring or rabbling. Immediately the boil has died down and a test shows a soft bath, a sample is sent to the laboratory for phosphorus estimation. The first slag is now poured off and a fresh lime slag put on. Fairly strong oxidising conditions are maintained until the laboratory report is favourable.

At this stage, carbon, silicon, manganese and phosphorus are reduced to a minimum, and are present in approximately the following quantities:—C.C, 0.09; Si, 0.008; Mn, 0.10; and P, 0.015 per cent. There is no reduction of sulphur during the period of melting and oxidising. The slag at this stage is quite black and inclined to brittleness after cooling, containing CaO, 40; FeO, 24; SiO_2, 17; MnO, 4; P_2O_5, 0.9 per cent.; Al_2O_3 remainder.

Oxidation Reactions

The chemical changes which take place during the 2-hr. period of melting and oxidation probably occur in three phases.

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(1) *Elimination of Silicon and Manganese.*—The silicon and manganese are oxidised by the presence of iron oxide added in the ore or included with the scale.

(2) *Elimination of Phosphorus.*—The elimination of phosphorus takes place secondary to the oxidation of silicon and manganese. Three definite conditions are necessary for the efficient removal of phosphorus: (1) excess oxygen; (2) very basic slag, and (3) low temperature.

(3) *Elimination of Carbon.*—Similar to silicon and manganese, the elimination of carbon depends upon the amount of iron oxide included in the charge or added in the ore. It is standard practice to take the carbon down to the minimum in order subsequently to recarburise to the hardness desired.

Removal of the Oxidising Slag

After the elimination of the carbon, silicon, manganese and phosphorus, the bath is ready for the removal of the oxidising slag. The removal is carefully supervised as the slag is carrying phosphorus and, under the reducing conditions which follow, this would revert to the metal. Slagging is conducted as follows:—The furnace is slightly tilted and the slag poured or lightly raked off, the load is then taken off and the electrodes raised. A little lime is added to thicken the slag, which greatly facilitates the slagging operation, and care is taken to remove all traces of slag from the sides and banks of the bath.

Skimming is conducted as rapidly as possible in order that heat should not be lost during this period. When the bath is in good condition, the complete removal of slag is accomplished in 7 or 8 min. To the slag-free bath is added 10 lbs. per ton FeSi to quieten the metal, which aids in producing a more uniform recovery when recarburising takes place for higher carbon steel.

Refining, Finishing and Tapping.—In the case of low carbon steels, no carbon is added at this stage, but for higher carbon steels 20 lb. of anthracite duff is thrown into the bath, followed immediately by one-half the total ferro-manganese addition. The bath is now ready to take the refining slag, which consists of 50 lb. of lime, 20 lb. fluorspar, and 7 lbs. coal dust. The load is again introduced and refining begins. The total refining time is approximately 1 hr., half of which is taken in forming the slag and the rest in deoxidising and acquiring heat.

Low power input of 3,500 amp. at 85 volts is used at first, when the slag is quite black in colour, and after about 10 min., as the slag begins to melt, a small amount of FeSi is added which hastens deoxidation. During this period the consistency of the slag is carefully observed, not being allowed to become too viscous or too thin. When the slag is too thick, contact with the metal is not made, and sulphur elimination does not proceed efficiently. If it becomes too thin, serious softening of the roof and walls takes place.

The slag is worked-up to strongly reducing conditions by the addition of lime and coal as required, and at this stage is white in colour, with a strong smell of acetylene denoting the presence of calcium carbide. At this point the power input is increased to 4,000 amp. Spoon samples are taken for general conditions of the steel and the metal quietened by small additions of FeSi. All samples during the refining period are taken with a cold spoon freed from metal and slag before use. The spoon is carefully warmed and slagged before dipping into the bath. Care is used to take the samples from the same position in the bath. When the metal is hot enough and the slag in good condition, a sample is taken for carbon. Final adjustment is made with hematite, and additions of 45 per cent. FeSi and 80 per cent. FeMn are added to bring these elements to the desired quantity. The additions of FeSi and FeMn are calculated from the known weight of metal in the bath.

TABLE IV.—*Electric Steel Tapping Temperatures and Times*

Electric furnace.	Shanking heats.	Bottom pouring heats.
	deg. C.	deg. C.
Tapping temperature	1,650	1,580
Temperature—first pour	1,600	1,560
Temperature —last pour	1,560	1,530
Time pouring	25 min.	20 min.
No. of moulds	80	67
Weight of metal cast	47 cwt.	45 cwt.

The additions are allowed to melt and the bath well rabbled with a bar before a sample is poured into a sand mould. This sample should be quiet and piping. The load is then taken off and the metal allowed to stand 2 or 3 min. before tapping to enable the slag to separate. The slag being highly basic and reducing conditions properly controlled, sulphur is efficiently reduced from 0.050 to 0.014 per cent. Tapping takes place through a tap hole built up with sand outside the door. Although this is a somewhat lengthy procedure, it prevents the slag from running with the metal, and avoids serious variation of carbon content and inclusions of non-metallic material. The metal is tapped into bottom-pouring ladles, which are preheated by

gas burners to approximately 800 deg. C., and aluminium is added as the bottom of the ladle becomes well covered. The tapping temperature for shanking steel is in the neighbourhood of 1,650 deg. C., and for direct-pour heats approximately 1,580 deg. C. Details of pouring times and temperatures are given in Table IV. Unit consumption is at the rate of 869 per ton, inclusive of coke-load and preheating. The temperature readings are taken with a Foster optical pyrometer, looking on to a clean stream of metal, and a correction of 7 per cent. added.

PART II—TROPENAS CONVERTER PRACTICE

Description of Plant and Converter Lining

The equipment in use consists of one 20-cwt. (nominal) Tropenas converter with a positive Rootes blower to furnish air. One Balanced-Blast cupola, 27 in. dia., capable of melting 3 tons of iron per hr., and one 2-ton capacity ladle for receiving the cupola iron for transfer to the converter; one lip pouring ladle from which steel is hand-shanked, and several bottom pouring ladles, all of which are preheated by gas burners. The vessel is nominally of 1 ton capacity, but the first charge is never less than 27 cwt., and this increases as the lining wears. The lining is 8 in. thick, except at the tuyeres side, where it is 11 in. There are five 1¼ in. dia. tuyeres formed in the rammed lining, for which a proprietary material is used. It is essential to control the moisture content at 8 per cent. during ramming, and to take steps to secure adequate drying and preheating before the first charge. The average life of a lining is 70 blows. The timetable is based upon a standardised converter charge, uniform vessel temperature and controlled blowing conditions. The tuyeres must be perfectly perpendicular to the axis of the vessel, an error of a degree or so prolonging the blow 5 to 8 min. and yielding cold steel.

Melting and Desulphurising

The cupola is fettled and patched each morning, this operation taking roughly 2 hr. The sand bottom is rammed up and a fire started which is allowed to burn through steadily without forced draft, and in about 2 hr. charging begins. As small converters cannot easily be held to size, no patching of the vessel takes place, and the capacity of the vessel increases during the week. Under these conditions a standard cupola charge of constant weight cannot be maintained without seriously modifying the chemical composition of the iron charged to the vessel.

To avoid variation of chemical composition in the charge to the converter, the cupola charges are adjusted. Experience has shown that the converter weight increases along the following lines:—At the beginning of the week, 27 cwt. are required, and, as little wear takes place during the first two days, three cupola charges of 9 cwt. to the blow suffice. After the second day the weight increases by 1 cwt. to 28 cwt., and four cupola charges of 7 cwt. are used. For the fourth day the converter weight will have increased to 30 cwt., and three units of 10 cwt. are used.

TABLE V.—*Cupola Charge Sheet.*

	No. of cupola charges in converter charge.	Weight of cupola charge.	Total converter charge weight.
		Cwt.	Cwt.
Monday	3	9	27
Tuesday ..	3	9	27
Wednesday ..	4	7	28
Thursday ..	3	10	30
Friday	3	10	30
Saturday ..	4	8	32

Table V shows the cupola charge details for the full week. In this manner a uniform composition is obtained without difficulty, as the following figures for six blows testify:

T.C (per cent.), 3.19, 3.03, 3.11, 3.03, 2.95, 3.00
Si (per cent.), 1.41, 1.41, 1.41, 1.35, 1.41, 1.13 (Si reduced)

The charges consist of 70 per cent. steel foundry scrap and 30 per cent. hematite pig-iron, the silicon being adjusted by the use of 45 per cent. FeSi to give a final silicon of 1.4 to 1.50 per cent. The coke used is of the Welsh variety, coke to metal ratio being 1:10. Chalk containing 55.0 per cent. CaO and having a moisture content of 1.96 per cent. is used instead of limestone, 25 per cent. chalk to coke by weight being used. Melting losses despite the sandy nature of the scrap and pig are constant at 5 per cent. Charging takes place immediately the bed has been made up, and as the cupola is hand-charged, the steel is charged first and the pig charged round the sides. Charging is completed in 40 min. The tuyeres of the cupola are set at a height that enables the cupola operator to secure enough metal for the converter in two taps. The taps run at regular intervals of 15 min. with intervals of 5 or 6 min. between each converter charge, during which time the tuyeres are cleaned and the slag-hole made up. Hot iron is secured from the cupola, the temperature being 1,460 deg. C. (optical pyrometer).

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Soda ash is used for desulphurisation, 1 lb. of sodium carbonate to 1 cwt. of metal being added to the receiving ladle before tapping. When the metal is tapped a violent reaction occurs, and heavy fumes are given off; after the second tap the reaction occurs again. Sulphur reductions as shown by recent analysis are as follow:—

Cupola..S (per cent.) 0.071, 0.080, 0.068, 0,078, 0.067
Ladle ..S (per cent.) 0.032, 0.037, 0.035, 0.035, 0.029

When the metal has come to rest, the ladle is removed from the cupola pit and the metal skimmed ready to be poured into the converter.

Blowing (Converting)

After desulphurisation, the weight of the metal is checked and poured into the converter, which is in the charging position. The vessel is run up and the level adjusted by the operator. Blowing always takes place on the same angle. A quadrant is attached to the vessel clearly showing the angle, divisions of 5-10-15-20 degrees being shown by a pointer which revolves with the vessel. Blowing takes place on the 15 degree mark. After the level is adjusted the blower is started and blast at 4 lb. per sq. in. pressure introduced, the operator records the time on a board and the blow is on.

A normal blow is as follows: As the blast strikes the bath, light yellow sparks and a small flame, going straight up the hood, proceed from the mouth of the converter. In about 5 min. a reddish brown flame appears directly over the tuyeres. This spreads and develops in length and marks the beginning of the ignition period. At this stage any FeSi that may be considered necessary is added to the converter in lumps. Three minutes after ignition the flame attains its full height, and a vigorous boil ejects a little slag and metal from the mouth of the vessel. At this point the blast pressure is gently reduced to 3 lb. per sq. in. and the vessel "moved up into the wind."

It is not considered good practice to reduce the blast pressure rapidly, as sudden reduction results in the loss of the flame. By the time the boil occurs, the bulk of the silicon and manganese have been oxidised, together with a small amount of iron which pass into the slag as silica, manganese oxide and iron oxide respectively. After reducing the blast the flame remains steady, being "solid" and having length, until about 12 min. after ignition when the carbon flame ascends voluminously and intensely white in colour. As the carbon becomes exhausted the flame becomes streaked and diminishes in length. At this point the converter is turned down, the blow is completed.

The bath at the end of the blow is in a highly oxidised condition containing approximately: C.C, 0.08; Mn, 0.005; and Si, 0.008 per cent. No reduction of sulphur or phosphorus takes place, and actually a slight increase of these elements occurs, owing to the blowing loss which is roughly 8 per cent. The practice of adding FeSi to the converter is only used when metal is to be hand-shanked. It is found that additions of FeSi have a pronounced effect upon the action of the flame, usually two or more boils taking place and, in the closing stages of the blow, it is not unusual for several false drops of the flame to take place before the carbon is finally exhausted. With such inconsistency of flame the possibility of under or over blowing is considerable.

Finishing and Tapping

After the converter is turned down, deoxidation takes place by the addition of 45 per cent. FeSi and 80 per cent. FeMn. The FeSi at the rate of 12 lb. per ton or 0.25 per cent. is added in tins, the slag being pushed away from the metal and the tins thrust into the bath. The FeMn addition is made by dipping the lumps in water and throwing them with force through the mouth of the converter, relying on the wet manganese to explode the covering of slag and penetrate into the metal. The loss of manganese is approximately 30 per cent., 1.40 per cent. being added to finish at 1.0 per cent. The metal is then well rabbled with a bar to work in any manganese that may have been trapped by the slag.

TABLE VI.—*Converter Steel Pouring Temperatures and Times.*

Tropenas converter.	Shanking heats.	Bottom pouring heats.
	deg. C.	deg. C.
Tapping temperature	1,660	1,600
Temperature—first pour	1,630	1,560
Temperature—last pour	1,575	1,530
Time pouring	25 min.	20 min.
No. of moulds	88	75
Weight of metal cast	32 cwt.	30 cwt.

The carbon is adjusted, when necessary, by the use of cupola metal. This method of recarburising is easily adaptable, quick and efficient, hot hand-shanks of pre-determined capacity being used. The actual time taken to recarburise a heat is 3 min. After recarburisation, the vessel is turned up to within a few degrees of the blowing position (in order to obtain the maximum movement of the metal) and back again to the pouring position,

then rabbled well with a bar to ensure homogeneity. The ladle is brought into the pit and the slag is held back to ensure that the aluminium which is added to the ladle will be taken up by the metal, after which the slag is allowed to run freely. The tapping temperature of converter metal compares favourably with electric furnace metal. Shanking heats are tapped at 1,660 deg. C. and bottom pouring heats at 1,600 deg. C. Table VI gives details of pouring temperatures and times.

the walls, which are rammed round a wooden former, 27 in. across by 51 in. high, sectional in construction to facilitate removal. The vitrified and burnt material is chipped off the face, leaving about 1½ in. to 3 in. old material round the shell. This is slurried down and the new material rammed into place with pneumatic rammers. The vessel is allowed to stand, drying naturally for as long as possible before being put into work.

Drying and heating are conducted as follows: A small coke fire is started and allowed to burn slowly for 15 hr., additions of coke being made

TABLE A.—*Properties of Steel made by the Two Processes.*

Heat No.	Composition, per cent.					Physical properties.			
	C	Si	Mn	S	P	Y.P. Tons per sq. in.	U.S. Tons per sq. in.	El. Per cent.	R.A. Per cent.
			Basic Electric Furnace.						
C. 10970	0·20	0·25	0·85	0·020	0·015	20·8	32·75	39	40
B. 3448	0·41	0·33	1·10	0·020	0·015	24·75	41·55	25	45
			Tropenas Converter.						
F. 9261	0·18	0·22	0·85	0·032	0·037	17·20	32·00	36	56
F. 8349	0·33	0·35	1·10	0·032	0·037	20·00	35·55	24	30

APPENDICES

Lining and Preheating of Electric Furnace

Lining.—The side walls and arches of silica bricks are built into position. The bottom is then made up as follows: One in. of ground magnesite is spread over the bottom next to the shell, over which is laid one course of 3-in. magnesite bricks, a further 1 in. of ground magnesite spread over the bricks followed by 2 in. of fine dry dolomite. The actual melting hearth consists of dolomite bonded with tar, rammed into place with pneumatic rammers. The tar is dehydrated (0.5 per cent. max. H_2O) and 8 per cent. by weight of tar to dolomite is used. The tar and dolomite are preheated before mixing but are rammed into the bath cold. The roof is built with silica bricks.

Preheating.—Coke is charged into the furnace and a load of 2,000 to 2,500 amp. at 80 volts is maintained. About 72 hr. heating is necessary to bring the bottom or neutral current into operation in a new furnace. Preliminary heating prior to the week's campaign is similar to the above with the heating time reduced to 6 hr.

Preparation of Converter Vessels

The bottom of the converter vessel is made up of three courses of 3-in. silica bricks. A well-known proprietary material is used for

as required. After 15 hr. approximately 5 cwt. of coke is added and air blown in through the tuyeres at 1½ lb. per sq. in. pressure. After blowing once up and down, a further 2 cwt. of coke is added and the blowing repeated. Blowing up and down is maintained for 30 min. in each operation; the vessel is then allowed to hang nose downwards with the tuyere box open. The daily practice is similar. After the nose has been made up, a fire is started at 8 a.m. and alternate blowing up and down the hood takes place at 30-min. intervals. The vessel is then turned down until the coke is withdrawn. Coke consumption increases as the size of the vessel increases and reaches a maximum of 10 cwt.

Physical Properties

Table A details the chemical composition and physical properties of the steels after normalising from 900 to 920 deg. C.

Fluidity

The question of the relative fluidity of converter and basic electric steel is often discussed. It is usually held that converter steel is more fluid than basic electric steel. In the experience of the authors, temperature is by far the strongest factor in fluidity. Temperature readings over a con-

(*Continued on p.* 292.)

DIAGNOSING A CYLINDER COVER CASTING

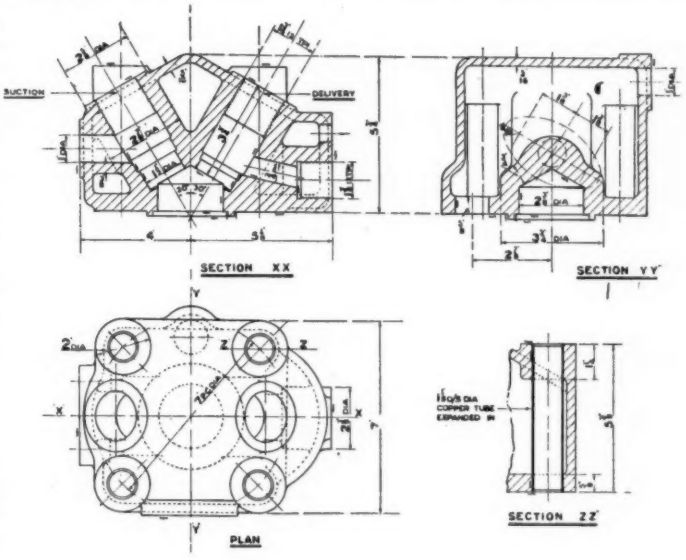
I.—GENERAL DETAILS EXAMINED

by A. F. HAMMOND

At recent meetings of the East Anglian Section of the London Branch the production of a specimen casting was discussed from various angles

The casting chosen is not a large or intricate type of job, and it will be discussed from the following angles:—(1) The drawing; (2) design; (3) specification and general requirements as to soundness; and (4) conditions under which casting has to work (pressures, etc.).

The Drawing.—Fig. 1 shows the casting to be a third-stage cylinder cover for a hydrogen compressor. It has only the general dimensions shown, so as not to make it confusing for those not familiar with reading drawings. This particular cover is one of a range of various sizes and shapes which are a standard product in the author's iron-foundry, but it should be added that this type of cover is also made in high-tensile bronze. Although not very large, and perhaps in itself very simple from a casting point of view, it does present possible difficulties due to its design and the very exacting work it has to do. Moreover, it has to undergo high pressure tests before being passed as satisfactory.



Co-operation in Design

Although always a very debatable matter, design does play an important part towards the achievement of the perfect cooling conditions desirable, and when the designer sets to work on any new component, he should co-operate with the head of the foundry department, as there is no doubt that simplicity in design helps to cheapen costs in production, commencing from the patternshop onwards. So often is this co-operation lacking, and it is obvious that still a great many drawing-office staffs do not understand the necessity for avoiding irregular shapes and for keeping to uniform sections, and, wherever possible, making gradual changes in sections. Admittedly, this matter is not always a simple or straightforward proposition, but a lack of knowledge of these points often results in surprise at the failure of a casting under its water tests.

Further, it is understood by the foundry that it is impossible to have every design of a uniform section throughout, and the foundry has to take its share of blame when some castings fail, due to the methods employed by the foundry itself. Included amongst these are pouring the casting with dull metal; choosing the wrong type and position of the runner or riser; entrapped gases, or bad venting of the core. Many other causes could be mentioned which occur, often due to insufficient thought and care being taken before attempting to produce the casting. In some firms consideration of weight of cast iron and the extra costs of greater

Diagnosing a Cylinder Cover Casting

metal thicknesses exert an important effect in the design of a casting. Often founders have to deal with designs, which carry very thin outer walls, made up with extra heavy flanges to which bosses and ribs are added for stiffness. Whether this type of design is stronger or not, its complications make the job more costly for the foundry. In the place of so much ribbing perhaps an extra thickness around the outer walls would have made the casting more uniform and very much cheaper in the long run. Labour costs are often found to be very much higher in proportion to the amount of metal saved at its price per cwt. In other words, the cost of producing a core to form a hole, or to lighten a casting, is often greater than the saving resulting from the elimination of drilling or from the reduced weight of metal.

Controlled Casting Conditions

Foundries fully realise that the ideal casting conditions are present in a casting with uniform sections, which solidifies progressively from the bottom upwards; unfortunately, ideals in foundry work are the exception and not the rule. Therefore, in castings of unequal sections an effort must be made to obtain as constant a rate of cooling as possible under the conditions. Many devices have been sought and tried in this direction, with varying results, but one which has as much support as any is the use of "chills or denseners."

Reference to Fig. 1 shows that this cylinder cover suffers from sectional changes, and at least two different rates of cooling and contraction will be formed—the light portion will cool rapidly, but the heavy portion will cool slowly, and in this way the casting will behave as though it consisted of two different parts, for in both portions of the casting the metal tends to draw away from the junction of the heavy and light parts. The outside shell has a $\frac{5}{16}$-in. metal thickness, joined at the bottom by a metal thickness of $\frac{3}{4}$ in. and at an angle of 30 deg. either side of the centre line; it has two heavy sections forming the valves, together with heavy bosses forming the suction and delivery valve holes. A cone-shaped hole at the bottom is covered by a $\frac{1}{4}$-in. metal thickness, and this metal joins up to the walls of the valves and tends to form a heavy section where all three meet.

Around these valves there are the water jacket, which has openings at four corners and at the water-inlet hole. It must also be taken into account that this casting is machined in most places, and machining allowances will help to increase those sections which are already the heaviest. Very often, in a casting of this type, a fracture develops along the junction of the two sections, and, even if this effect is not produced, it is found that a plane of weakness inevitably follows; and whilst this is bad so far as strength is concerned, it is equally bad with respect to its soundness, and, as a general rule, weak areas developed in this manner are porous and will fail to respond when subjected to a water-test pressure.

Specification and Soundness

Because this cylinder cover is used in a machine compressing hydrogen to a pressure of 900 lbs. per sq. in., it will be realised that an essentially sound casting is necessary. It is imperative that the hydrogen must not leak into the water spaces, and the suction and delivery holes must not leak into one another; also, the fact that hydrogen leaks through porous places much more readily than air makes it necessary to put this casting under a very strict test. When the machining has been completed, full inspection is made to ensure no signs of open or coarse-grained sections of metal, and the two valves and valve holes are put under a water-test pressure of 2,000 lbs. per sq. in. This being satisfactory, the water jacket is subjected to a hydraulic pressure of 50 lbs. per sq. in., the two tests being carried out separately.

Taking the engineering grey-iron castings as a whole, they can perhaps be divided into three classes:—(1) Miscellaneous castings; (2) structural castings; and (3) pressure castings.

The subject under consideration enters into the class of the pressure castings, and it is here that it seems desirable to end this introductory Paper by the following quotation from a Paper by H. H. Judson:—"Pressure castings are quite dependent upon the absence of draws, shrinks, spongy spots, coarse graphitic carbon, and demand a dense, fine-grained homogeneous structure in order to be serviceable. The structure of the iron, as for instance the amount of graphitic carbon present, and, more important still, the condition in which this graphite exists, is of paramount interest in castings subjected to pressures."

To this should be added that the correct analysis and temperature of the metal, together with control over the way it is introduced to the mould, play equal parts towards the attainment of a sound casting.

DISCUSSION

MR. E. LESTER said that if for the casting a straight unalloyed iron was used, resort would have to be made to chills, but they could be eliminated by using alloyed cast iron.

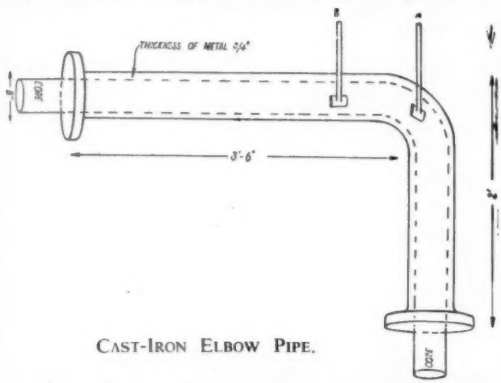
MR. G. HALL, chairman, expressed his preference for high-duty cast iron, and thanked Mr. Ham-

(*Continued on page* 292.)

SETTING A CHAPLET ON AN ELBOW PIPE

By W.G.

The sketch shown in Fig. 1 is of a recently made cast-iron elbow pipe which turned out to be a waster. It was caused through the inadequate setting of the chaplet which holds down the core. This is a type of casting when a simple operation like fixing a chaplet is, in fact, the most important, and where exactness is necessary if equal pressure under the core is to be maintained when the mould is filling with metal. With a pipe of this design and diameter of bore, one chaplet for holding down the core should be sufficient. The mistake made in this case was the misplacing of the chaplet. Instead of being set on



CAST-IRON ELBOW PIPE.

the centre line of the bend, as shown at A, in the sketch, it was placed four or five inches from that point, as indicated at B. This seemingly unimportant detail, easily made by the unwary or inexperienced moulder, weakens the resistance of the chaplet to hold down the core at the point where the greatest pressure takes place, thus allowing the core to "lift," more or less, resulting in uneven thickness of metal or more likely a scrap casting. In the moulding of much larger bend pipes, say, of from 12-in. bore and upwards, it is best to set two chaplets. These are placed at each side of the bend ensuring greater security in preventing the core from rising.

The Nickel Bulletin.—The June issue of the Nickel Bulletin contains some abstracts of topical interest. American work on electrodeposition as applied to armament, heavy nickel plating, production of permanent magnets and the arc welding of passivation of stainless steel, are among the items included. Copies of the Bulletin may be obtained, free of charge, on application to The Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1. Individuals are requested to give the names of their firms or otherwise indicate the nature of their interest.

NEW BRONZE SPECIFICATION

The A.S.T.M. has recently issued Specification B60—41 covering the 88:8:4 type of bronze. The minimum desired and maximum requirements are as follow:—

	Minimum.	Desired.	Maximum.
Cu per cent. ..	86.00	88.00	89.00
Sn " " ..	7.50	8.00	11.00
Pb " " ..	—	none	0.30
Zn " " ..	1.50	4.00	4.50
Fe " " ..	—	—	0.25
Ni " " ..	—	—	1.00
P " " ..	—	—	0.05

The minimum tensile strength is to be 17 tons; the minimum yield point 7.2 tons, and the minimum elongation 22 per cent. on 2 in. The test-pieces are 6½ long by 1 in. wide at the top, tapering to 6 in. by ¾ in. at the bottom. After a depth of 4 in. the test-piece is centrally necked to $\frac{5}{16}$ in. to form the gate of a ½-in. test bar with 1 in. diameter shoulders. No chilling is allowed. For testing the bar is machined to ½ diameter with a ± 0.01 in. tolerance. Castings weighing 250 lbs. or more are to carry at least one test-piece attached, and those below that weight must have at least one or share one with another casting to represent the metal from one melt. Separately cast bars may be used where attachment to castings is impossible.

GERMAN VITREOUS ENAMELLERS

At a two-day conference of German vitreous-enamelling associations, held at Thale am Harz last November, a series of Papers were read on a variety of technical subjects, including the principles of vitreous enamelling on cast iron, stresses in castings, the general properties of boron-free enamels as compared with boron-bearing enamels, economic considerations of the supply of raw materials to the industry, opacifiers for boron-free cast-iron enamels, substitutes for boron and the manufacture of boron-free white cast-iron enamels, and hairlining and flaking of cast-iron enamel. Discussions also took place on frit preparation, patent questions, testing methods, and the desirability of evaluating technical tests for various types of enamel suitable for works' use.

Solubility of Tin in Magnesium.—To investigate the solubility of tin in magnesium, pressed wires of alloys of these two metals were first submitted to different heat treatments and then their electrical resistance measured. The conductivity-concentration, resistance-concentration and resistance-temperature curves were used to deduce the position of the solubility and solidus line in the Mg-Sn diagram. The phase boundaries are located at 200/0.45 (deg. C./per cent. of Sn), 250/0.8, 300/1.35,350/2.5, 400/4.4, 450/7.1, 500/12.2, 600/7.2, and 625/3.2, according to investigations described by H. Vosskühler in "Metallwirtschaft."

ELECTROGRAPHIC ANALYSIS IN METALLURGY

Electrographic methods of chemical analysis, although known since 1929, have been recently developed to a high state of usefulness, states Prof. E. A. Arnold in "Steel." The principal advantages offered by these methods of analysis are:—First, the sample is not destroyed; second, the methods are rapid, requiring only times measured in seconds, or, at the most, minutes; third, colour reactions are used entirely, thus making the identification more positive; fourth, the result shows any uneven distribution of the metal sought.

The principle of electrographic analysis is extremely simple. It is well known that if a metal is made an anode in an electrolytic cell, oxidation takes place on the surface and ions of the anode enter the electrolyte solution. Further, since the ions are charged positively, they are directed towards the cathode and lateral diffusion is negligible. The application of these principles to electrographic analysis is at once evident. The metal itself is made an anode with an inert metal as a cathode. A filter paper or any other suitable unsized paper is soaked with a solution of a reagent that gives a precipitate with the metal ions to be investigated. This paper is placed under slight pressure between the anode and cathode and a voltage applied for a definitely measured time of the order of 5 or 10 secs., rarely longer than 1 min. The metallic ions passing into the solution react and form either a characteristic coloured precipitate or a colourless one. This contact print is then treated with various solutions to dissolve out of the paper other ions dissolving at the same time, or, in some cases, to react with a colourless precipitate to produce a coloured one. After suitable washing, the print may be dried and preserved.

Detection of Nickel, etc.

To determine whether or not a sample of steel contains nickel, a piece of the steel to be tested is employed as an anode in the test. It is covered with a piece of filter paper saturated with a solution of dimethyl glyoxime and dilute acetic acid. The electrical circuit is closed for the proper length of time and small amounts of both nickel and iron are dissolved from the surface and enter the solution in the pores of the filter paper. The nickel ions react with the dimethyl glyoxime to form a very characteristic red precipitate of nickel dimethyl glyoxime.

The iron which enters the solution as the divalent ion tends to form a brownish stain which somewhat masks the red precipitate characteristic of the nickel. But this interference on the part of the iron can be overcome readily by washing the print in very dilute acetic acid. The nickel precipitate is insoluble in this medium while the iron compound is soluble. After washing with water, the nickel precipitate becomes easily distinguishable against the white background of the filter paper.

Another case where this technique is of value is in showing pinholes in metallic coatings. The inspection of chromium-plated surfaces may be used as an example. The paper in this case is impregnated with a solution of dimethyl glyoxime made alkaline with a dilute barium hydroxide. When the electrographic exposure is made, the chromium leaves the anode as the oxidised chromate ion and reacts with the barium hydroxide in the paper to form a yellow insoluble barium chromate while nickel exposed by pinholes in the chromium plate enters the paper and forms red insoluble nickel dimethyl glyoxime. After washing the excess reagents out in water much as one washes a photographic positive on paper, the print appears as a yellow coating with red spots in it wherever a pinhole existed. It is easy to see how this might be an extremely useful test.

One further example shows a modification of the technique. Zinc forms no simple insoluble coloured compounds so that, if a zinc or zinc-coated material is to be examined, the filter paper is impregnated simply with a salt solution such as sodium acetate. Zinc passes into the paper as zinc ions and a small amount of acetic acid is formed. The compound of zinc is neither insoluble nor coloured, and immediately the paper is fixed by immersing it in a dilute sodium sulphide solution. The zinc then reacts with the sodium sulphide to form insoluble, but white, zinc sulphide. The zinc compound on the paper is now insoluble, but still not visible against the background of white paper. It is next rinsed thoroughly in dilute acetic-acid solution, which removes the excess sodium sulphide. The paper is then treated with a dilute cadmium chloride solution, and the white zinc sulphide is replaced by yellow insoluble cadmium sulphide, which is visible.

Apparatus and Procedure

The apparatus for making electrographic prints is fairly simple. The sample is contained in a press. Between the bottom plate, made of inert or relatively inert metal, such as platinum or aluminium, and the specimen is inserted the unsized paper impregnated with a solution of the proper reagent or reagents. The specimen is held in place by clamping by means of a hand-wheel. The specimen itself is connected to the positive pole of a 6-volt storage battery, while the bottom plate is connected to the negative pole. In the electrical circuit, there are the necessary toggle switches and rheostats, so that the voltage may be controlled and varied at will.

When the circuit is closed, the metal from the anodic specimen dissolves and passes into the paper at a rate controlled by the strength of the current and in a quantity controlled by the time during which the current flows. The washing, fixing, and developing reactions can then be carried out in separate small porcelain dishes. Reagents used to impregnate the paper in which the reaction takes place may be chosen from those suggested by Prof. Feigl in "Qualitative Analysis by Spot Tests." When the reagent is an organic one or dissolved in an organic solvent, a salt must be added to make the solution an electrical conductor. So far, all of the suggested uses have been qualitative in nature, but a procedure has been proposed for making the method quantitative.

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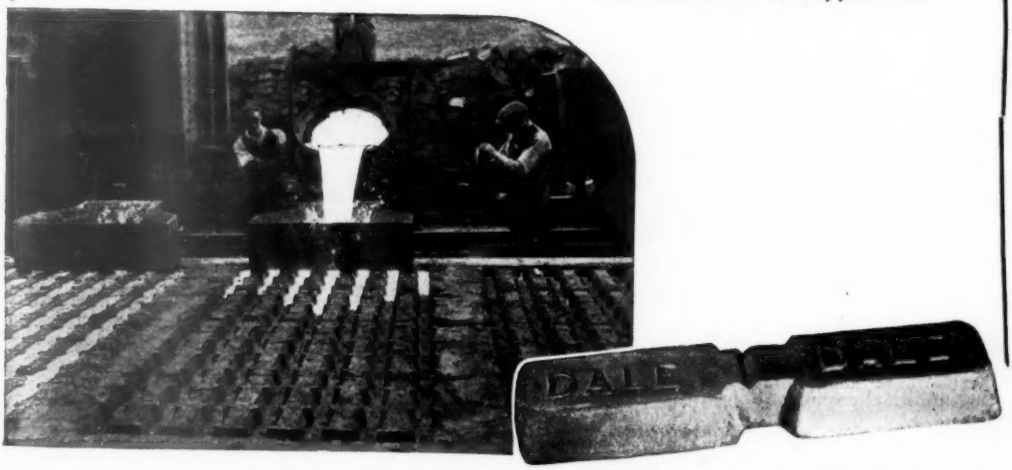
Users are invited to avail themselves of the Stanton Technical Service which offers free expert advice on special mixtures and other Foundry problems.



THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

PRODUCTION OF UNIFORM STEEL FOR A LIGHT CASTINGS FOUNDRY

(*Concluded from page* 286.)

siderable period have shown that converter steel is consistently 40 to 60 deg. C. hotter than electric steel. It is their opinion that with well-made steels the difference in fluidity of the two types of steel at the same temperature is very small.

Non-fluid steels are occasionally encountered and, in the case of electric steel, this is usually found to occur in heats on which the boil has been unsatisfactory. This is often followed by a prolonged period under the final reducing slag. The steel is frequently found to be high in Si and to contain considerable inclusions. In no discussion on fluidity has any reference been found to non-fluid converter steel. Yet this occasionally occurs. It appears to be associated with cold iron in the converter charge and an extended period before the boil begins. A very fluid and sloppy slag high in FeO is formed and it appears that this results in a high proportion of non-metallic inclusions. It would be interesting to know if there is any definite evidence that lack of fluidity is associated with the presence of inclusions.

CATALOGUES RECEIVED

Welding.—Brochure No. 35, "Arc Welding of Aircraft," has just been issued by the Lincoln Electric Company, Limited, Welwyn Garden City. It confines itself to the thin gauges of steel used, mainly chrome molybdenum, and details not only the operating conditions for depositing two types of specially-designed electrodes "Planeweld," but also gives the post-welding heat treatment. Temperatures are given in Fahrenheit degrees; this is a nuisance, as most British metallurgists are accustomed to thinking in terms of the Centigrade scale for this class of work. Some useful sketches for welding tubular frame joints are included. It is available to our readers on writing to Welwyn Garden City.

Skin Protection, Sternol, Limited, Grey Timbers, Westerham Road, Limpsfield, Oxted, Surrey, have sent us a booklet which, after dealing with the various causes of dermatitis, outlines the benefits to be derived from the use of Sternocleanse. This preparation is applied to the hands before the hands are exposed to any danger. This very interesting pamphlet should be read by all shop managers, for it not only discloses a potential "lost-time" preventive, but it may solve other problems connected with part-time women-labour.

SAVING WASTE PAPER SAVES SHIPPING

DEATH OF MR. G. C. LLOYD

MR. GEORGE CHRISTOPHER LLOYD, secretary of the Iron and Steel Institute from 1909 to 1933, died on July 10, at the age of 81. Finishing his education at the Moravian School at Königsfeld, in Baden, he served an apprenticeship as mechanical engineer at the works of Robert Stephenson & Company, Newcastle-upon-Tyne. Later he was engaged as a marine engineer, first in the service of Lamport & Holt, of Liverpool, and then in the Spanish Royal Mail Steamship Company, "Compañia Transatlantica." He spent some eight years at sea, ranking as an Extra First-Class Engineer. He left the sea to take up a position with the Mirrlees Watson Company, Limited, Glasgow, as their representative in Germany, Austria, and France, later leaving that company to become assistant engineer with Jeremiah Head & Son, consulting engineers, in Westminster, who at that time represented the Wellman, Seaver, Morgan Company, of Cleveland, Ohio. In 1901 he was appointed assistant to Bennett H. Brough, then secretary of the Iron and Steel Institute, and four years later became secretary of the Institution of Electrical Engineers. On the death of Mr. Brough in 1908, he was appointed secretary of the Iron and Steel Institute. From 1909 to 1914 he also held the positions, first, of member of council, and then of vice-president, of the International Association for Testing Materials, and regularly attended their meetings wherever they were held. He retired from the position of secretary of the Iron and Steel Institute in 1933, when he was succeeded by Mr. K. Headlam-Morley. From that date until his death he was honorary secretary of the Institute.

PERSONAL

MR. GEORGE WEST BYNG has been appointed a full-time executive director of Dorman, Long & Company, Limited, Middlesbrough. Mr. Byng for the past twenty years has been associated with the administration of Barclays Bank, Limited, and for fourteen years has been an assistant general manager. Throughout that period he has been closely associated with industrial developments and has devoted his attention particularly to the heavy industries.

Wills

COULTHURST, ALCIMUS, engineer and ironfounder, of H. J. & A. Coulthurst, Limited, Robert Street Foundry, Darwin	£,23,355
WHITEHEAD, J. E., of Whitehead & Poole, Limited, engineers and ironfounders, Radcliffe, Lancs ...	£4,895

DIAGNOSING A CYLINDER COVER CASTING

(*Continued from page* 288.)

mond for having provided the sectioned wood models, enabling the job to be properly visualised.

MR. HAMMOND, in reply, emphasised that the casting he had chosen was sufficiently simple to enable the younger craftsman to discuss it from every aspect, and added interest would be given if dealt with from both the one-off and quantity production aspects.

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SUPPLY DEPARTMENT CONTRACTS

COSTING AND PRICE FIXING

The Association of British Chambers of Commerce has issued a pamphlet containing useful explanations given by the Ministry of Production regarding the normal procedure of departments in dealing with contractors and sub-contractors in connection with contracts for the supply departments. The pamphlet gives information concerning the facilities for assistance, advice, and appeal, which are open to all contractors and sub-contractors, and affords guidance as to the purpose of contract clauses and cost investigations. Copies of the pamphlet can be obtained from the secretary of the Association, 14, Queen Anne's Gate, London, S.W.1, price 3d.

Last March the Association submitted a memorandum on the subject of supply department contracts to the Chancellor of the Exchequer. This has since been discussed in conference with representatives of the Treasury, Admiralty, Ministry of Supply and Ministry of Aircraft Production. The criticisms raised by the Association were sympathetically considered and further explanations given as to the normal procedure of the departments. It was agreed to be in the public interest that these answers and explanations should be brought to the notice of those concerned in work for the supply departments. Hence the present explanations. Some of the points raised by the Association, with the official replies, are given below; there are many others in the memorandum:—

Cost-Plus Contracts

"The 'cost-plus' method of price fixing puts a premium on inefficiency and extravagance."

The Minister of Production and the supply departments agree with the Association in their dislike of the cost-plus contract, but point out that it is impossible to get away from it altogether, especially in in its modified form as a maximum price contract. Many firms are unable to make firm tenders in the first instance and prefer to adopt a maximum price contract which necessarily involves post accounting. A fixed price is only possible where both the contractor and the department can feel reasonably confident from their respective points of view that it is a good price.

"When a firm signs a contract, it often has no idea as to the price which will eventually be allowed."

It is agreed that the basis of price ought to be settled as early as possible in a contract.

"The practice of the supply departments varies widely in the price-fixing clauses."

Methods must necessarily vary according to the nature of the requirement or supply. In order to secure increasing uniformity of practice, points of principle are, however, co-ordinated at regular meetings of all supply departments.

Profit Margin

"Attempts to relate profit to capital are causing difficulties."

This is a matter on which further enlightenment of manufacturers is desirable, particularly to assure them that the rate on capital was only one of the factors taken into account in ascertaining the price to be paid to them; that rates of profit are not fixed by hard and fast formulæ, and that all departments, in agreeing the profit margins, take into consideration all the circumstances and make concessions to encourage and reward the initiative and efficiency of firms.

"Delays in price fixing are causing serious difficulties, particularly to small and medium-sized contractors."

It is admitted by the departmental representatives that there has been some delay in fixing prices owing to shortage of staff, but progress payments are not thereby affected, and in the experience of the departments these have been made sufficiently generously and promptly to avoid any substantial grounds for complaints.

TRANSFER OF SCOTTISH FOUNDRY WORKERS

The position of moulders and fitters who returned home to Falkirk dissatisfied with wages and conditions of labour at a drop forge in the English Midlands, where they had been sent under the Government's transfer of labour scheme, was reviewed at a meeting in Glasgow between representatives of trade unions and of the appropriate Government authority. It was explained that unless men were engaged on essential war work, they were liable to be sent where they could be employed on such work. The fact that they might be at present engaged in the manufacture of stoves and pipes, even if these were to Government contract, did not count against the more urgent needs of the moment. If the men were opposed to being transferred from their present job, they could appeal, but the only grounds on which any such appeal could be heard and sustained was that of hardship.

It is understood that the direction under which the men originally proceeded to England has been withdrawn, and they are to be issued with a fresh direction under which they will be required to proceed once more to England to take up work of a different nature from that which they were reluctant to accept.

OBITUARY

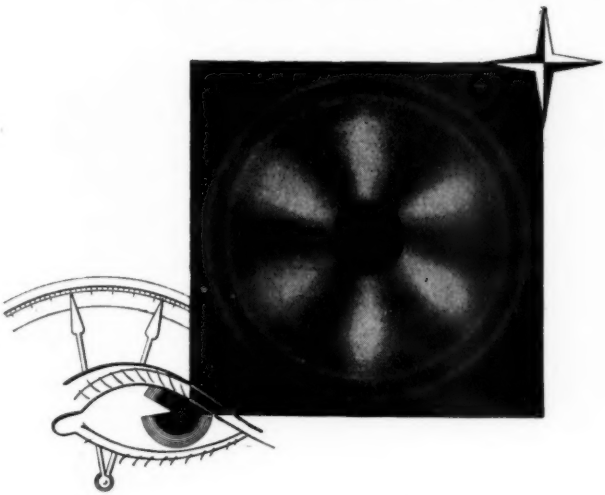
MR. W. H. HOWLETT, director and general manager of G. R. Turner, Limited, railway wagon builders, engineers and ironfounders, of Langley Mill, Notts, has died in his 65th year. He was a past-president of the Nottingham Society of Engineers, and was widely known in engineering circles in the Midlands.

MR. HUGH GIRVAN, for many years a well-known figure in London steel trade circles, died at Worcester on July 3. He was in his 82nd year Mr. Girvan was senior partner in the firm of Hugh Girvan & Son, King William Street House, Arthur Street, London, E.C.4. He had been in business for over 50 years, mainly in the galvanised sheet trade, and for a long period was agent in this country for the Belgian Phenix Works.

SEVEN PILLARS OF PROGRESS

2. Communities depend for their existence, their survival and advancement on the knowledge of themselves and of the properties of things in the world around them.

"The Charter of Science"—British Association, 1941



Scientific method concerns itself with the approach, by successive stages of ever increasing refinement, nearer and nearer to exactitude. In this way the scientist builds up that wonderfully detailed knowledge of the properties of materials which permits the engineer to use them to greater advantage. From the beginning of the century scientific development in the iron and steel industry has given the engineer a new series of alloy steels with properties far transcending those of their simple forerunners. The process of painstaking investigation continues. The creep of metals, grain size and its control, the X-ray examination of atomic structures of materials, are but a few of the fundamental researches now in progress in our own Central Research Department. It is thus that science advances the development of the power station, the aeroplane, the automobile and a host of major adjuncts of civilization which have altered the course of human life, labour and leisure.

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NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

544,277 CLEVELAND, F. J. (Soc. Anon. Officine di Villar Perosa). Bearings constituted by a nitrided steel having a high surface and core hardness, and their manufacture.

544,332 NEILSON, D. H., and DAVY & UNITED ENGINEERING COMPANY, LIMITED. Hydraulic tilting gear for Bessemer converters and the like.

544,349 ABBEY, A. (Dow Chemical Company). Calcium base alloys.

544,350-2 ABBEY, A. (Dow Chemical Company). Magnesium base alloys.

544,386 WALDRON, F. B. Manufacture of solid drawn iron and steel tubes.

544,394 WATSON, F. (American Ore Reduction Corporation). Treatment of ores.

544,401 STANTON IRONWORKS COMPANY, LIMITED, and WILSON, P. H. Manufacture of castings by a centrifugal process.

544,415 GIBSON, A. R., and ELECTRO-CHEMICAL ENGINEERING COMPANY, LIMITED. Pickling treatment of metals or alloys.

544,628 TITANIUM ALLOY MANUFACTURING COMPANY. Refractories and methods of making the same.

544,640 ABBEY, A. (American Chemical Paint Company). Production of phosphate coatings on ferrous metal surfaces.

544,660 POWER RESEARCH CORPORATION. Sheet-metal piston ring.

544,663 CUCKOW, A. E. E. Method and means of fixing wall boards and the like to steel and wood structures.

544,667 EVANS, S. D. O., ENDERMANN, H. M., and QUEENSMERE PROPERTIES & INVESTMENTS, LIMITED. Salt-bath furnaces.

544,678 WILLIAMS, W. P. (Armco International Corporation). Process of making electrical sheets of silicon steel.

544,691 LUCAS, LIMITED, J., and MITCHELL, G. S. Apparatus for use in the hardening and tempering of steel articles.

COMPANY NEWS

(Figures for previous year in brackets.)

Dickson & Mann—Profit of £1,169, reducing the debit balance to £1,916.

A. C. Wickman—Net profit for 1941, £33,180 (£59,101); ordinary dividend of 12½% (same).

Greenwood & Batley—Profit, after tax, for the year to March 31 last, £103,034 (£112,783); dividend of 15% (same).

Thomas Bolton & Sons—Profit for the year to March 31, after taxation, £162,152 (£161,852); depreciation on fixed assets, £78,838 (£70,000); to war contingencies reserve, £10,000 (nil); debenture interest, £18,000; preference dividend, £15,000; final ordinary dividend, 5%, making 7½% (same); forward, £78,157 (£77,822).

NEWS IN BRIEF

THE ANNUAL GENERAL MEETING of the Institute of Welding, Limited, is to be held at 2, Buckingham Palace Gardens, London, S.W.1, on Wednesday, July 29, at 3.30 p.m.

MR. WILLIE MURGATROYD, 5, Walker Place, Windhill, Shipley, Yorks, ironfounder, is paying a supplemental dividend of 2s. 5½d. in the £, payable at the Official Receiver's Office, Hallfield Chambers, 71, Manningham Lane, Bradford.

CLYDE CONFEDERATION of Engineering and Shipbuilding Trades has negotiated an agreement with the employers for an increase of out-working allowances. Existing rates will be advanced by 25 per cent. on all jobs three miles and more away from the regular place of employment.

THE FEDERATION OF BRITISH INDUSTRIES has accepted an invitation from its American opposite number, the National Foreign Trade Council, to concert measures for post-war economic reconstruction. The Federation has submitted as a basis for discussion the report it prepared recently at the request of the Board of Trade.

FOUR HEAVY IRON GATES which have just been contributed to the scrap metal campaign were manufactured about 1790 by one of the many designers who copied the methods of De Loutherbourg, a painter of Polish origin, who, in 1777, presented the first "set" scenery ever used on the British stage. The gates toured the country with various "super-shows" in the nineteenth century.

"PLANNING FOR PART-TIME WORK" is the title of a booklet issued by the Ministry of Labour and National Service dealing with the mobilisation of woman-power, which has reached the stage when women with domestic responsibilities must be brought more fully into the war effort. The booklet gives full details of ways in which women's part-time services may be harnessed to industry. Copies may be obtained from the local office of the Ministry of Labour and National Service.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Stirling Implements, Stirling Foundry, Orchard Place, Stirling. £450. J. and W. Davie.

David Muir & Sons—Engineers, ironfounders, etc. W. Muir, 73, Marjoribanks Street, Bathgate, and J. S. Muir.

B. W. Johnson & Sons, Lock's Mill, Nailsworth, Glos—Engineers, metal founders, etc. £5,000. B. W. and A. W. Johnson.

Metallurgia, 142, St. Vincent Street, Glasgow. £5,000. Scrap metal recoverers. W. Y. Buchanan, J. Fleming and D. Murray.

Eastwood & Lazenby Bros.—Engineers, etc. £4,000. W. D. Eastwood, Carr Mount, Rawden, Yorks, C. H. and E. H. Lazenby.

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Raw Material Markets

IRON AND STEEL

Business in iron and steel for delivery after the end of the month has been rather less active of late, due to the uncertainty regarding future selling prices, which may possibly be increased following the advance of coal and coke prices. The tendency to hold back orders is especially noticeable in high-phosphorus iron, of which many foundries have extensive reserve stocks on hand.

Heavy engineering foundries remain as active as ever and their order-books are full up for some time ahead on contracts of national importance. Replacement orders are promptly forthcoming, and this state of affairs is likely to obtain indefinitely while industry remains on a war footing, as the products of this branch are urgently required by the various Government departments. Their raw material requirements are being satisfactorily met on the whole, but not without a certain amount of difficulty, as supplies of the grades of iron which these concerns normally use are not so readily available as they were when it was possible and practicable to import large tonnages of foreign ores and scrap metal. Hematite iron, for example, is being very carefully distributed, and is, in fact, handed out only to consumers whose needs dictate the use of this material. Where it is possible for a substitute quality to be employed, the latter has to be accepted. Low- and medium-phosphorus irons, too, are not distributed except after applications for licences have been carefully scrutinised.

The Control authorities are keen that high-phosphorus and refined irons, steel scrap, etc., should be used in mixtures in place of the better-quality irons, and this method has been adopted with good results by many concerns. High-phosphorus iron, which is manufactured from ores found in the United Kingdom, is obtainable quite easily, and many users have ample supplies on hand to cover their future needs. The light-castings foundries are normally the largest users of this type of material, but their consumption has declined appreciably since the outbreak of the war, as their turnover is nothing like so extensive now that various restrictions have been imposed upon their trade.

Makers of foundry coke are kept fully occupied in dealing with the demands of consumers, many of whom are steadily accumulating large reserve stocks. There is no trouble in securing extra tonnages for stocking purposes, as producers are willing to negotiate on a forward basis and all contracts of this nature include a rise-and-fall clause which covers both parties against any change in price which might be introduced by the Control. The recent advance in the quotation has not in any way placed a brake on the flow of orders. For delivery to Birmingham and Black Country stations, the current price of Durham best foundry coke is 69s. 3d. per ton.

New business in the steel industry is to some extent under the influence of holidays in various districts, but activity in the grades required for Government contracts is maintained. Special qualities are particularly brisk, while plates and special qualities of finished sheets are also in very heavy demand. Makers of cold-rolled strip and bright-drawn steel bars continue to be fully engaged.

On the whole, the steelworks are still open to receive additional deliveries of scrap metal, but some other consumers continue to refrain from making further purchases until they have worked off a proportion of their existing stocks. The tone in the market is thus easier than it was a few months ago, but, even so, there is room for more scrap suitable for the steel furnaces. Heavy steel scrap is wanted more especially, but deliveries of most other descriptions appear to have overtaken the demand, and in some sections of the trade business is inclined to be dull.

NON-FERROUS METALS

Adequate supplies of zinc ore and spelter continue to arrive at ports of the United Kingdom, and the war factories and other essential consumers are not being denied their legitimate needs. Other users, however, are getting little response to their applications for supplies, as the Control authorities are determined to economise in the usage of the metal. The American Zinc Institute announces that spelter deliveries by producers in the United States during the month of May last attained the record total of 83,601 short tons. Production during the month was 79,489 tons, against 77,034 tons in April and 73,449 tons in May, 1941. Stocks on May 31 at 18,447 tons were the lowest since last August.

Stocks of refined copper held by fabricators in the United States at the end of April last, at 255,620 short tons, were the lowest recorded for many months, and compared with 273,044 tons on March 31. Unfilled purchases at the end of April were higher at 237,548 tons, against 231,312 tons, while fabricators' working stocks were also slightly higher at 285,980 tons, compared with 282,474 tons. Unfilled sales by fabricators to customers showed a marked rise at 632,474 tons, against 574,888 tons at the end of the previous month. Actual consumption of copper by fabricators in April was 124,103 tons (124,154 tons in March), while at the end of April fabricators' stocks of refined copper were 425,286 tons less than the unfilled orders on their books, compared with a deficiency of only 353,006 tons at the end of March. In normal times fabricators have on hand moderate excess stocks over unfilled orders.

A Bill was recently introduced in the U.S. House of Representatives with the object of stimulating the domestic production of tin. The aim of the Bill is for the Metals Reserve Company to be authorised and directed to purchase all tin produced in the United States territory for the duration of the war and for three years afterwards, and to pay for it at least $1 per lb. and in any event not less than the market price if that price should be more than $1 per lb.

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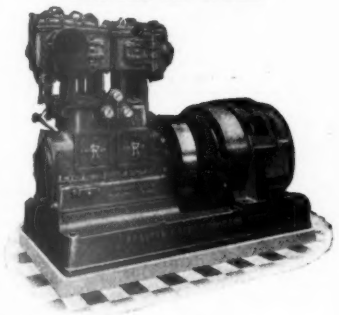

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